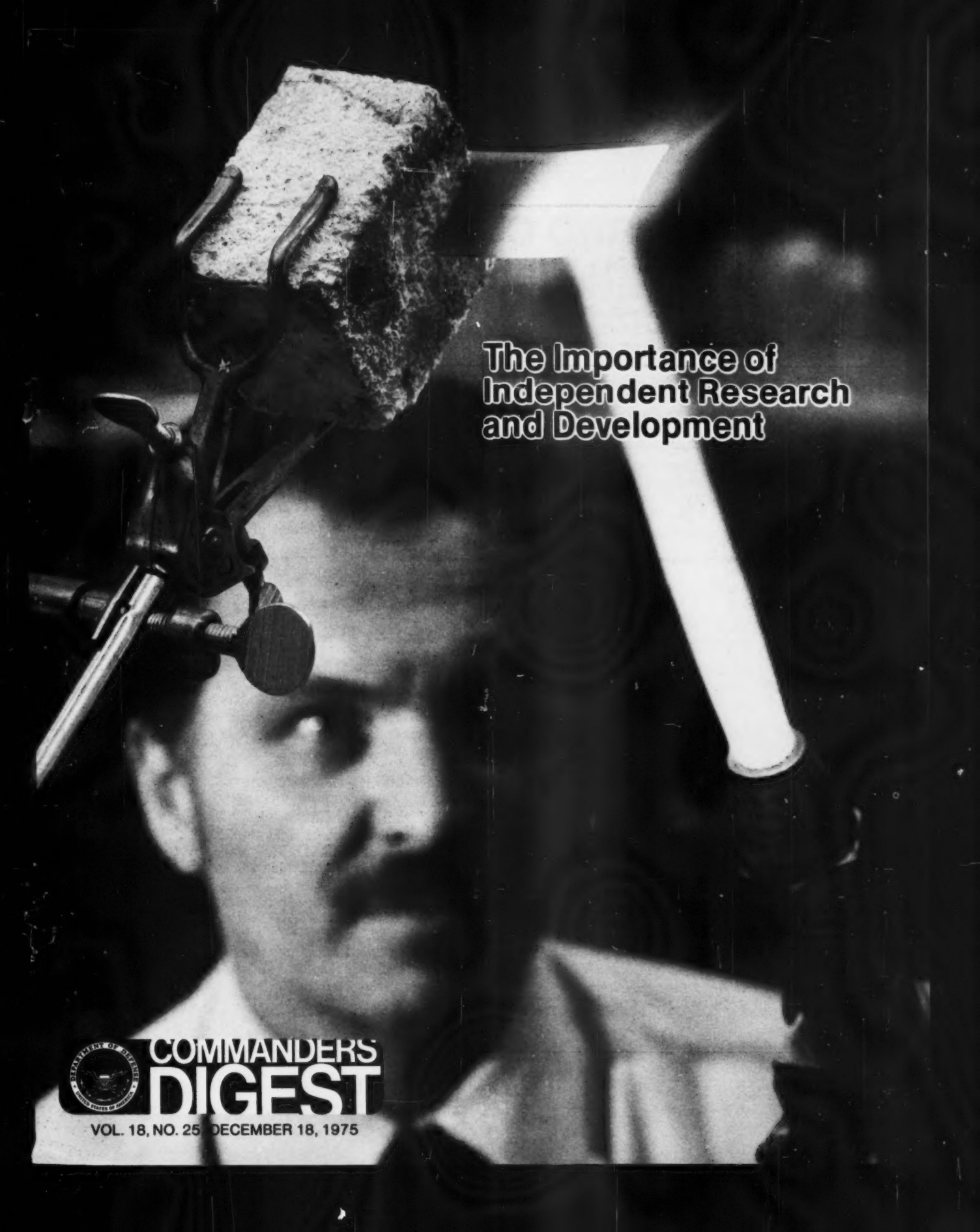


The Importance of Independent Research and Development

COMMANDERS DIGEST
VOL. 18, NO. 25 DECEMBER 18, 1975

How IR&D Competition Benefits National Defense

The Department of Defense maintains the following views on the critically important subject of Independent Research and Development (IR&D) and Bidding and Proposal Effort (B&P).

These views are influenced by the varied DoD perspectives gained in long association with the management of IR&D and B&P or its equivalent in the defense industry, in commercial industry and in government.

These views are also strongly influenced by DoD's current responsibilities to the Congress and to the Nation which include

- assuring the maintaining of quality and level of defense-related technology which will insure national security for the future, and
- efficiently acquiring needed defense systems capabilities at minimum overall cost to the government.

A recent General Accounting Office (GAO) study ("Contractors' Independent Research and Development Program — Issues and Alternatives", June 5, 1975) strongly endorses the concept of IR&D/B&P and generally supports the manner in which it is administered by the Department of Defense. This two-year comprehensive effort by the GAO complements similar efforts by the Commission on Government Procurement, by the Inter-Agency Task Group on IR&D, and by a distinguished group of government and academic leaders under the auspices of the Defense Science Board. These recent studies have all examined the policies and procedures for IR&D as evolved over almost two decades of experience in DoD and National Aeronautics and Space Administration (NASA) and have examined the value of IR&D from different experiences and points of view. All of them provide endorsement for the concept of IR&D/B&P and generally for the policies and procedures currently used in its implementation.

In this statement the value and significance of IR&D/B&P and its management by the Department of Defense will be discussed. The more important issues, including those raised by the GAO, will then be covered, and finally, suggestions will be offered for enhancing the benefit of this resource to the Government.

By Dr. Malcolm R. Currie
Director of Defense Research and Engineering

The developers of the Controlled Avalanche Transit Time (CATT) triode prepare it for a test at the General Electric Research and Development Center, Schenectady, N.Y. This triode could possibly be used by DoD in radar, [illegible]ion, and [illegible]igation [illegible]ent.

Fundamentals

IR&D is often referred to as a "program" with the implication that the "IR&D Program", like contract program effort, is just another mechanism for achieving particular pre-conceived end-item results. Although it is true that IR&D does achieve results of immense value to the Nation's base of technology and innovative capability, the concept of it as a "program" is far too narrow and misses completely its more fundamental significance.

The Nation's military security — indeed, its broad economic security — depends in large measure both on a wide base of advanced technology and also on the efficiency with which this technology is translated into end-item capabilities which are superior in performance and cost to those of competitors. The competitive forces in the free enterprise system have been fundamental to the productivity and standard of living, to DoD's ability to compete successfully in the world marketplace, and to the attainment of a defense capability which must be based increasingly on technological quality and efficient production rather than sheer brute-force quantity at any cost.

Competition has been this Nation's tradition and strength. This fundamental dependence on competition has been recognized explicitly — it is conscious national policy that the Department of Defense should rely primarily on competition to select sources for developing and producing its military hardware and services.

This policy has a price. The price includes assuring the continued existence of sufficient number of organizations qualified to meet DoD's needs so that a truly competitive environment can exist. This involves — as it does in commercial business — the cost of maintaining, in an organization, a level of innovative technology within that organization's fields of business interest so that it can compete effectively. It also involves the costs of the competition itself. Similar costs are borne by the Government in preparing for and conducting the competitions.

The reason DoD is willing to pay this price for its policy of competition is the belief that the returns to this Nation are immensely greater than the investment it involves. DoD is able to achieve a highly productive flow of new and innovative technology and an overall efficiency in its application and production unparalleled anywhere.

A technician at an industrial research and development center holds a candle to have her picture taken by the world's most sensitive solid state television camera.

At a time when this Nation's defense Research, Development, Test and Evaluation (RDT&E) effort and overall investment in force modernization has been reduced constantly year by year and is now about half that of the Soviet Union, the Defense Department has been able to maintain a competitive technology and military posture only because of the productivity of DoD's system which is rooted in this competitive process.

IR&D, and the independent aspect of its management by industry, therefore takes on an importance of underlying significance. It is, in fact, absolutely fundamental to a competitive industrial capability which is the high-payoff cornerstone of DoD's economic system. This is the reason IR&D/B&P is referred to as "a necessary cost of doing business" and is logically an overhead expense.

And, although DoD expends considerable effort each year in reviewing IR&D for its "relevancy" and for its "reasonableness in overall level" and although many efforts are instituted to couple it closely to Defense needs as DoD perceives them, undue governmental control of IR&D in a direction to reduce its independence would, in DoD's view, destroy the fundamental policy and thesis from which it has been derived.

Now, if the basic tenets underlying the policy of competition, and therefore underlying the IR&D process, are valid, it follows that IR&D should be extraordinarily productive. DoD asserts that it is. The IR&D effort, administered essentially as it is at present, is an absolutely indispensable element in DoD's ability to maintain a broad national base of superior technology and military capability. Its benefits pervasively affect the quality and productivity of the entire Defense RDT&E effort and therefore exert enormous leverage on the totality of the Defense weapons acquisition process.

Why is IR&D/B&P so productive? It is aligned with the basic competitive and motivational forces of a free enterprise economy. It involves the prime attention of the most creative technical and management people in thousands of companies — all independently

determining through this competitive process their degree of success and their economic future. It therefore multiplies many-fold the capabilities of the relatively much fewer governmental personnel, no matter how competent and creative those personnel might be. Its characteristics are — understandably — innovation, high productivity and efficiency in the evolution of technology. It reinforces all other parts of the Nation's technological effort in a direction to lower the cost and improve the quality. It is a prime mover of inestimable value.

All of the above is why a simple listing of specific examples of IR&D, such as an idea for a high energy laser, a basic concept for nanosecond computers, a key development for aircraft propulsion, an imaging infra-red missile seeker, digital radar signal processing, etc., although impressive, is finite and wholly inadequate to express the larger benefit and impact of IR&D. This is why the benefits of IR&D are not amenable to simple cost-effectiveness analyses and why, as reported in the GAO study, one-dimensional auditing efforts per se have been difficult and inconclusive.

The Department of Defense has recently issued a policy statement regarding the value of and the rationale for the allowance of IR&D/B&P expenses. The statement is contained in DoD Directive 5100.66, "Establishment of Policy for, and Technical Evaluation of, Independent Research and Development Programs." The following passages of interest are quoted from that directive.

"IR&D/B&P is recognized by the DoD as a necessary cost of doing business particularly in high technology environment. Through support, consistent with the cost principles established in Armed Services Procurement Regulation (ASPR), of contractors' IR&D/B&P programs, DoD seeks to:

- Assure that creation of an environment which encourages development of innovative concepts for Defense systems and equipment which complement and broaden the spectrum of concepts developed internally to DoD
- Develop technical competence in two or more contractors who can then respond competitively to any one requirement DoD seeks from industry.
- Contribute as appropriate to the economic stability of its contractors by allowing each contractor the technical latitude to develop a broad base of technical products."

Independent research and development center scientists demonstrate how a new composite material that combines the resistance of ceramics with many of the properties of metals is able to resist heat.

Management by DoD

The directive described in the preceding paragraph also establishes the basic framework for the management by DoD of the IR&D/B&P Program. The directive establishes the top policy body for IR&D, that is, the DoD IR&D Policy Council. Its members

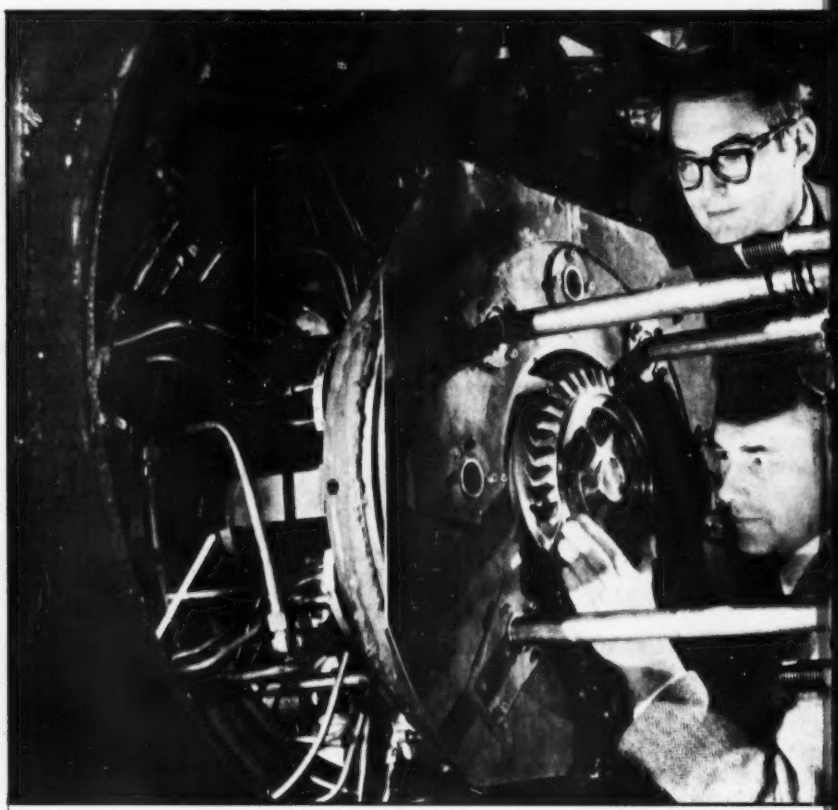
include the Deputy Director of Defense Research and Engineering, the Assistant Secretaries of Defense for Comptroller and Installations and Logistics (I&L) and the Assistant Secretaries of R&D and I&L for each Military Service. This policy body meets regularly and examines the various issues arising from the policy and implementation of IR&D.

The directive also establishes an IR&D technical evaluation group as the working body for the Policy Council. The evaluation group is chaired by a member of the Director of Defense Research and Engineering staff and has as its members the departmental IR&D managers. As members of the technical evaluation group the IR&D managers serve as a staff body for proposing policy positions relative to any aspect of IR&D and as a development body for procedures necessary to the technical administration of the contractors' IR&D Program. As departmental IR&D managers, they manage the technical evaluation of the contractors' programs assigned to their Service.

The departmental IR&D managers exercise their managerial functions through a network of focal points in each DoD laboratory and technical organization. These focal points have the responsibility to identify and task individual evaluators for the technical plan evaluations and for the on-site reviews. The evaluation results flow from the individual evaluators back through the focal points within each organization to the departmental IR&D managers and the technical evaluation group.

The last element in the management of the IR&D Program is the negotiation of the ceilings for recovery of IR&D/B&P. Each Military Service has established a central office for IR&D negotiations within its materiel command. These negotiators, using the technical evaluation results for the current year along with several other factors such as historical IR&D levels, current sales levels, etc., negotiate a ceiling for IR&D/B&P considered reasonable for each contractor for a given fiscal year.

Scientists at one of the independent research and development centers are working on a water-cooled gas turbine that would generate twice the power of those now in use.

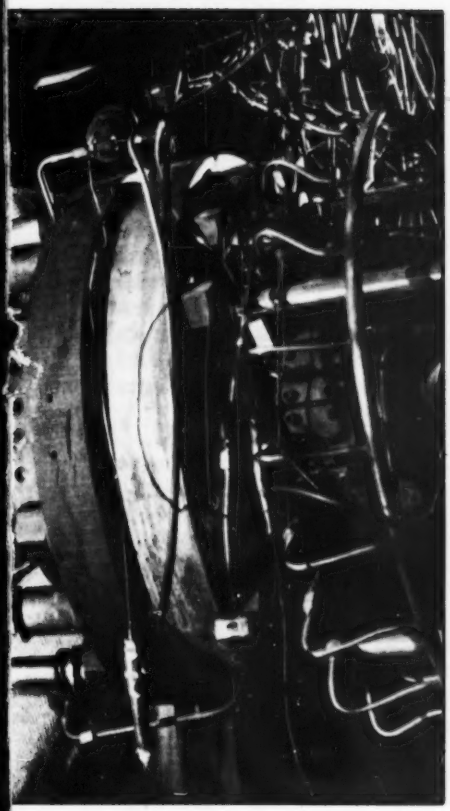


The critics of the evaluation process have stated that many times the evaluators have not been well qualified. DoD takes issue with this position. Each of the Military Services have gone to great lengths to try to use the best qualified professionals for evaluation, considering the many demands placed on the services of such men. When one considers the vast range of technical disciplines represented by the IR&D of the many contractors of the Department, one can't help being impressed at the excellence of the job being done to evaluate IR&D projects whose technical write-up occupy the equivalent of four large four-shelf bookcases.

Issues concerning IR&D

While Dod has a primary concurrence with the report of the General Accounting Office (GAO) relative to the value, the need, and the rationale for support of IR&D, there are some residual issues. These issues are:

- Statutory declaration of IR&D policy
- Degree of control and appropriate amount of support
- Rights to data and patents



resulting from IR&D

- Access to commercial records of a contractor for IR&D audit allowance
- The focus of relevance of IR&D
- Uniform treatment of IR&D/B&P government-wide
- Visibility of IR&D

Statutory Declaration: The GAO recommended that the Congress clarify the policy for IR&D support by establishing guidelines which set forth the purposes for supporting IR&D, the appropriate amount of support and the degree of control which should be exercised over the program. DoD concurs in possible statutory language setting forth the purposes for which the Government supports IR&D costs and suggests consideration be given to the policy statement of DoD Directive 5100.66 or to the first two points of the Commission on Government Procurement Recommendation B-10 namely:

—Recognizing the IR&D and B&P expenditures as being in the Nation's best interests to promote competition, advance technology, and foster economic growth.

—Establishing a policy recognizing IR&D and B&P efforts as necessary costs of doing business.

However, we do not believe that statutory guidelines are appropriate which attempt to set forth either fixed amounts of financial support or the degree of control to be exercised by the Government over contractor programs. These are considered executive management decisions for which flexibility of action must be retained in order to adapt to the many differences among contractors in product areas, sales levels and trends, the level of cost consciousness induced by contract mix, technology quotient in each industrial segment, etc. This issue is fundamental and its resolution will have far-reaching implications.

Degree of Control: It has been suggested that IR&D be based on budget line item funding and therefore that it involve contracts or grants in its administration. The reasons given for these proposals are "better controllability" and "better accountability" and that the Government need then "buy only what it needs."

These proposals overlook the fundamental nature and significance of IR&D and would subvert the primary purpose for which it is intended. IR&D must be understood and accepted not as something which is purchased but as something which, as discussed earlier, is fundamental to doing business in the competitive environment on which this system is founded. It is a cost of operating an enterprise just as are employee health benefits and retirement plans.

DoD feels that the Government has gone as far as reasonable or desirable or economically sensible in the control and accountability of the process. Control is currently exercised to the degree necessary to protect the Government. Further controls as have been proposed would, in effect, change basic national policy. Transforming IR&D into something akin to directed research and development puts the Government potentially in the position of deciding and controlling the future of individual organizations making up the industrial base. At a time when the great strength of our system is individual action and competition, any move toward increased governmental bureaucratic control and potential stifling of competition must be viewed as a giant step backwards — it has not worked successfully elsewhere! Most studies recommend less direct control rather than more and DoD concurs with these recommendations.

Beyond these basic reasons for rejecting the concept of line item funding and the concomitant directed control of IR&D, there are several other important considerations.

Line item funding would cost the Government much more for the same overall effort. For example, in fiscal year 1974, $1.053 billion of independent effort was reviewed and judged to be relevant to DoD. Of this, the DoD share was $457 million. DoD thus reaped the benefit of $596 million of technical effort which it reviewed and influenced but which was absorbed elsewhere. This benefit would tend to be lost in directed procurement because industry would no longer have the same competitive incentive to invest other resources in projects of interest to the Government. This would inevitably result in the weakening of the

Several independent research development firms have joined together to develop high-power lasers to produce controlled thermonuclear fusion. The laser system, when completed, will be used to heat and vaporize fuel pellets in a target chamber.

Nation's technical base.

Secondly, the administrative costs of managing a budget line item allocation and direction of IR&D would be excessive. Either IR&D contracts or grants to thousands of small companies would have to be administered at great cost to Government and industry or, in the absence of this uniform treatment, these small companies would fall behind and become less cost competitive with the larger companies in which "IR&D" support was provided by contract rather than by overhead recovery. In any case, the number of companies with the technical capability to compete would diminish because those not granted funds would fall behind.

The detailed administration of this scheme would also involve major efforts of key technical manpower in the DoD laboratories and would further divert the energies of this important resource. The quality and level of the in-house technical effort would be reduced significantly at a time when DoD is striving to build up the quality and vitality of DoD laboratories.

In summary, DoD believes that increased direct control of IR&D implied by line item budgeting and by contract or grant administration would tend to destroy the fabric of the present highly competitive system — forces would be set into play which would decrease the quality of the technical effort as well as its magnitude. The Defense Department's already shrinking technical base would suffer with nothing meaningful gained. DoD believes these risks to be unacceptable.

Patent and Data Rights: As a recommendation in its recent report, the GAO recommends that legislation provide for including in advance agreements patent and technical data provisions granting the Government royalty-free licenses and data rights, based on a scale of the agency's cost

participation in IR&D recovery. The Department of Defense continues to support its long-standing position of not acquiring patent and data rights in the results of IR&D. There are several reasons for Defense's position which are both philosophical and practical. The Assistant Secretary of Defense for Installation and Logistics stated many of both the philosophical and practical reasons in a 1964 letter to U.S. Senator John McClellan. At the bottom of this page are several of the pertinent passages from that letter. **This statement is just as true as it was 11 years ago.**

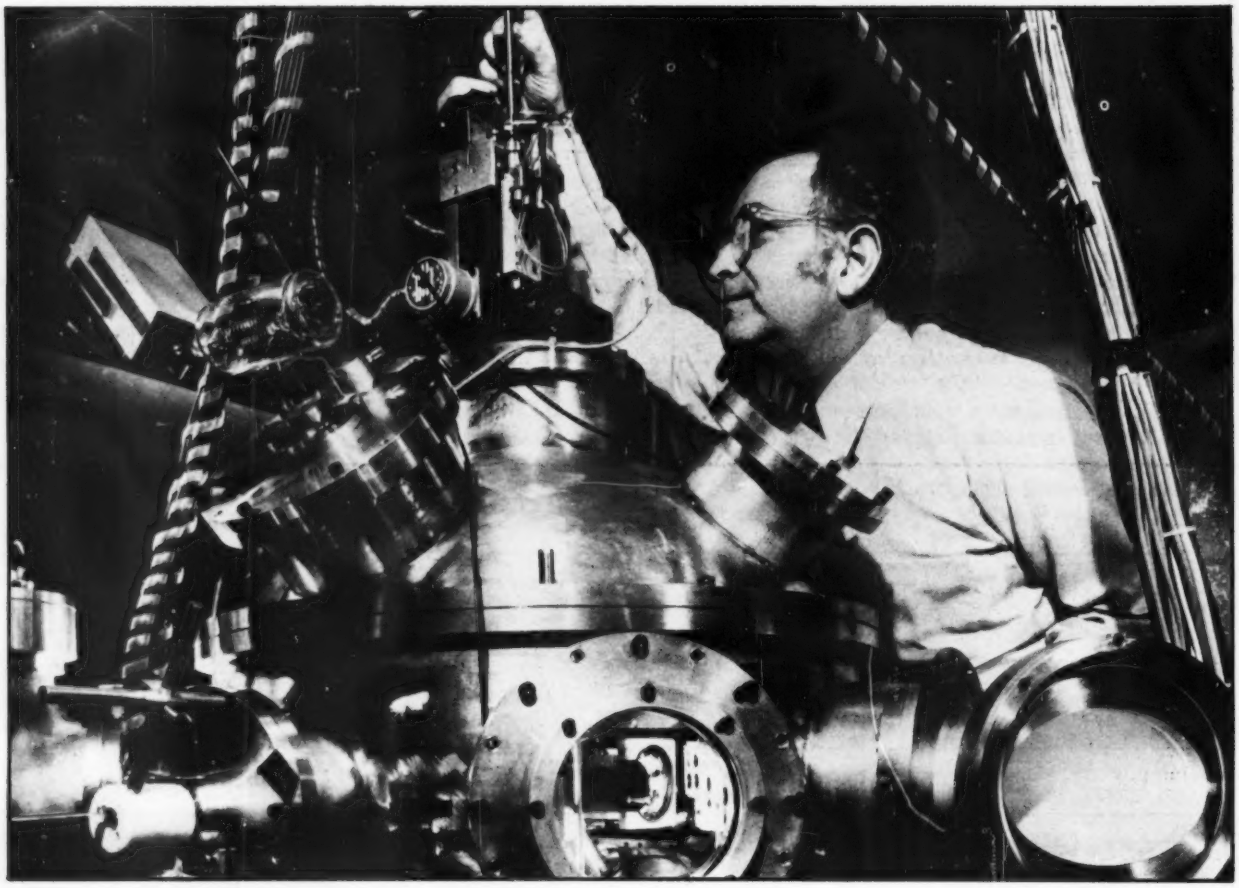
There are several other practical reasons why the GAO recommendation should not be accepted. The administration of such a policy would be quite difficult to carry out. For example, at what point would the Government have funded sufficient of the IR&D program to demand rights? Would the Government receive full rights for funding a portion of an IR&D program, though that portion may be no greater than 50 per cent? It is equitable to demand rights greater than those demanded by other customers of a contractor particularly when, in many cases, the other customers are the vehicles for a substantial amount of recovery yet do not ask for similar rights? Consider also that data and patent rights from only those contractors negotiating advance agreements would be available as a result of the GAO recommendation yet similar data of the great bulk of contractors, though their IR&D programs may be small, would not be available. Still another problem concerns the rights to items or processes developed at private expense where the source of funds was profit rather than the contractor's overhead.

The difficulty of establishing an equitable position capable of being administered on this issue coupled with the lack in the past of any significant difficulty by DoD in acquiring the rights to use needed

"The Government does not stand in any special relationship as a customer, and it, like other customers, should pay its share of the cost of operating an industrial firm which includes IRD program costs. It therefore, as any other customer, does not seek or expect patent rights when the price it pays for commercial products includes costs of IRD programs. Nor does the Department see any rational basis for applying more stringent rules, such as requiring patent rights if it supports IRD programs, simply because the contractor happens to have sales predominantly to the Government; provided the IRD expense is allocated to all customers on a fair and reasonable basis. We recognize, however, that in these instances there is greater than normal need to provide assurance that the expenditures are reasonable, i.e., no larger than would be spent by a prudent management in a commercially oriented business."

"We believe that the position recommended in the report is contrary to the best interests of the Government because it would inevitably result in discouraging businessmen from using their engineering talent and other resources for the development of products designed to meet the needs of the Government. —The policy expressed in the report would effectively smother this incentive as far as defense contractors are concerned by making it clear in advance that rights in data resulting from a company's independent research and development efforts would have to be turned over to the Government."

"If companies that develop new products for Government use, at their own risk and initiative, may thus be denied the rewards normally afforded successful risk takers under our economic system, they will obviously have little motivation to continue to expend money, talent and other resources on the development of Government-oriented items. This would be a serious loss."



A scientist adjusts instrumentation on the target chamber within which fuel pellets of deuterium or lithium deuteride will be heated and vaporized by bursts of light from a high-power laser system. This research and development is being accomplished at the University of Rochester under joint sponsorship of several independent research and development firms.

IR&D results suggests strongly that acquiring the rights to use IR&D data and patents, when needed, is not a major issue.

Access to Commercial Records: In its report, the GAO also recommended that the Government have access to a contractor's commercial records when needed to determine that costs are allowable. The DoD has been studying this area and has been considering the advisability of requiring contractors with advance agreements to certify that IR&D programs do not include costs required in the performance of contracts. DoD believes it feasible to use such a certification signed by the contractor at the time negotiations are completed for the advance agreement.

Focus of relevance of IR&D: The Department of Defense has been conducting determinations of the relevancy of contractors' IR&D projects to the DoD missions for the past few years in response to the requirements of Section 203 of Public Law 91-441. DoD's experience with this activity indicates the implementation of the relevancy requirement has caused no great problem and that the nonrelevancy of IR&D projects to the DoD has averaged about 8 per cent of the total number of IR&D projects proposed for execution. It should be pointed out that few, if any, IR&D projects are actually disallowed since nearly every contractor has sufficient business with other than DoD to recover the costs of nonrelevant projects in

such business. It should also be pointed out that if a uniform Government-wide application of IR&D policy and procedures is instituted and the Government is to present a single face to industry, then a broader range of technological interests than DoD must be considered relevant. This range of interests is broad enough as to make the significant administrative chore of reviewing each and every IR&D project of every contractor of every Federal agency highly questionable as a cost effective endeavor.

Government-wide treatment of IR&D/B&P: The Department of Defense supports the concept of a uniform Government-wide treatment of IR&D/B&P and suggests that the development of such uniformity should be the responsibility of the Office of Federal Procurement Policy (OFPP). IR&D is essential for any agency which needs a base of technically competent and competitive contractors. Equitability demands that the treatment of IR&D by these several agencies should be consistent from agency to agency and from contractor to contractor. In conjunction with the idea of uniform Government treatment, the DoD also supports the concept of presenting a single face to industry; that is, a single advanced agreement, joint technical review, and a single overhead rate. We believe that the lead agency approach based on the predominant contracting agency would work well as it has between DoD and NASA in the past few years. DoD, however, disagrees with the GAO in having this "single face" approach implemented by legislative action. A legislative policy statement establishing the purposes of IR&D support and recognizing IR&D/B&P as necessary cost of doing business would be useful. However, attempting to implement a specific approach to uniformity via legislation does not fully recognize the dynamics of the situation and would be inappropriate and unduly constraining. Again, the Office of Federal Procurement Policy offers and excellent vehicle for achieving these objectives.

Visibility of IR&D: Another issue has been the question of the visibility of the individual IR&D allowance to each contractor and the technical results of that allowance. The Department of Defense reports annually to the Congress on the amount of IR&D incurred by each contractor in each of the contractor's divisions and subsidiaries, the amount of the IR&D incurred that was considered reasonable for a prudent contractor to spend in the same circumstances and lastly the amount of IR&D to be recovered in DoD contracts. This report is submitted on March 15 to the Speaker of the House and to the President of the Senate. The report is available to every senator and representative but must, of course, be treated as proprietary since it contains information concerning each contractor's total program funded by his profit and by his other customers as well as by the Department of Defense.

The technical results of the effort funded by the IR&D allowance is summarized each year in the contractor's technical plan for IR&D. This plan, submitted during the first quarter of the contractor's fiscal year, contains statements of the objectives of each IR&D project as well as the approach being considered in achieving these objectives and the progress made in the last period. These plans are widely distributed throughout DoD and NASA laboratories both for evaluation and for study. The detailed technical report of the effort when completed is available upon request by a DoD or NASA professional. Again, these reports are handled as proprietary since they represent a contractor's best efforts to be competitive in his field of endeavor.

To enhance the dissemination of the IR&D technical information to all interested professionals within DoD, a data bank concerning IR&D has been established which contains summary information on each IR&D project underway or completed by each contractor. The GAO has helped DoD in this development. The information is catalogued in a number of different ways, permitting searches to be made in a variety of manners such as key words, performing organizations, etc. This data bank can be read out at some 50 secure, remote terminals located at key points in our technical organizations. The data can also be provided on written or telephone request from those professionals who do not have ready access to a remote terminal.

All of these mechanisms, in addition to the periodic in-plant reviews and the many-fold technical interchanges between industry and government via direct visits, technical conferences and symposia provide relatively high visibility of the IR&D results of major DoD/NASA contractors by those in Government who require this information.

Management Suggestions

Several DoD suggestions already have been identified in the prior paragraphs of this statement. However, this is summarized for the sake of completeness.

DoD recommends a Congressional declaration of policy concerning IR&D. The declaration should contain a statement similar to that contained in DoD Directive 5100.66 mentioned earlier. With this declaration of policy and the charter of the Office of Federal Procurement Policy, the need for the current Section 203 of Public Law 91-441 no longer would exist.

DoD further recommends that the Office of Federal Procurement

An independent research and development center physicist checks a newly developed 32-million-bit, all-electric memory that will enable computers to access stored information up to 1,000 times faster than the same capacity mechanical drum memory in the background. Support of the development project was provided in part by the U.S. Army Electronics Command.

Policy be charged with the responsiblity for developing, coordinating, issuing and auditing the implementation of an OMB circular establishing a uniform and consistent treatment of IR&D/B&P across the Federal Government. The treatment would generally follow the recommendations of Dissent Position 1 of the Commission on Government Procurement with the access to commercial records satisfied by the certificate approach and the rights to needed IR&D data and patents satisfied by contractual means rather than wholesale assumption of rights to all data and patents whether needed or not. The OFPP treatment should establish uniform criteria for determining a reasonable level of IR&D/B&P for each contractor, the relevancy of the effort and the rules for allocability.

It is reiterated by DoD that the IR&D effort comprises a fundamentally important and pervasive part of the U.S. technical base. This Nation cannot afford experiments and changes in policy which would alter its essential characteristics.

The notion that IR&D is a subsidy or a giveaway is erroneous. On the contrary, it actually represents a great bargain to the Government. In 1974, on the average, 92 per cent of all IR&D projects were directly relevant to DoD interests while, on the average, DoD paid only 39 per cent of the cost of the IR&D effort incurred. For this discounted payment, the Government is able to maintain the most advanced technology and innovative systems in the world.

One real difference between the United States and the Soviet Union is the quality of independent competitive initiative in the development of U.S. technology. This is why this Nation is ahead, and why the competition spends almost twice as much to catch up.

It would be ironic indeed if this Nation failed to appreciate and support the strengths of this present system and if the Government were to move towards increased monolithic control at a time when the rest of the world and the Soviet Union itself are trying hard to emulate the United States.

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